

April 28, 1996

The Honorable Reed E. Hundt
Chairman
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20545

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MAY 1996

RE: RM8784 Petition of Sky Station International, Inc.
Amendment of the Commission's rules to establish requirements for a Global Stratospheric Telecommunications Service in the 47.2-47.5 GHz and 47.9-48.2 GHz frequency bands

Dear Chairman Hundt:

Upon examination of the concept advanced by Dr. Alfred Y Wong on SkyStation I would like to make the following commendations:

1. This concept has the advantages that it does not require launch vehicles such as rocket or plane, thus reducing both the cost and environmental impact.
2. The SkyStation is a Stationary Platform which operates in the Stratosphere. It makes use of the ambient atmosphere and the solar energy. This enables it to stay aloft for a long period of time. In addition it is environmentally compatible. It does not inject additional energy or pollutants into the atmosphere, thus making it environmentally friendly.
3. SkyStations do not require expensive launches or maintenance vehicles and are located at an altitude within easy reach for two way communications. Its payload is large and does not require expensive packaging. As a result the operating cost is expected to be much lower than conventional satellites.
4. The ion engines deployed represent a very different approach to propulsion. These engines use the neutral gas present in the space environment as a fuel and does not require the use of pressurized gas. Unlike conventional ion or chemical engines, there is no safety issue associated with the fuel tanks.


Philip Leung Ph.D
Independent Consultant

Experience of the author

I have worked on the Space Station in the area of power system and environmental interactions. I have extensive experience in the area of space charging of vehicles and I am an internationally recognized expert in this field. My participation in US space program has included earth-orbiting satellite and interplanetary spacecraft.

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Summary

Electromagnetic Compatibility (EMC) and Electrostatic discharge (ESD) engineer/scientist specializing in evaluation and implementation of proper EMC/ESD design in spacecraft system, subsystem and assemblies.

Areas of Expertise

EMC/ESD requirements definition	EMC/ESD test and analysis
EMI shielding and grounding	Computer simulation
Space environment and effects	Space material selection
Space Instrumentation	Electronics packaging
Spacecraft anomaly investigation	Reliability engineering
Radiation transport	Plasma physics

Education

Ph.D. in experimental plasma physics, UCLA, 1979.
MS in physics, UCLA, 1974.
BA in physics and mathematics, summa cum laude, St. John's University, Minnesota, 1973

Work Experience

Jet Propulsion Laboratory, 1980 - present
Member of Technical Staff - Reliability Engineering Section

Chief EMC/ESD engineer for the Cassini spacecraft, responsible for requirements definition, design implementation, test planning and execution. Interface with US and foreign partners of the Cassini program to ensure the requirements imposed by various engineering subsystems and science instruments are fully implemented. Authored the EMC Control Plan for the Cassini program. Responsible for technical direction and task assignment to a group of four EMC engineers. Significant achievements included the early implementation of EMI control techniques in power converters; EMC assessment of RF transmitters and receivers on board the spacecraft; modification of pyro-circuitry for the elimination of ground fault current; control of RF signal emitted by frequency generators and high speed

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electronics, identification of candidate conductive white paints for use on spacecraft surfaces.

Lead engineer of the Galileo ESD control program, responsible for the research to quantify the risk of internal ESD. Research led to the generation of the widely accepted internal ESD avoidance guidelines.

Co-investigator of the Internal Discharge Monitor flight experiment on the Chemical Release and Radiation Effects Satellite (CRESS), responsible for material selection and ground testing.

Task manager and lead engineer for various research programs on spacecraft charging, electrostatic discharge and EMC phenomena. Designed and fabricated facilities to perform spacecraft charging and EMC studies. Developed the techniques to measure the EMI generated during a discharge. Work has led to many publications (see attached list) and world wide recognition in the area of space environment effects.

EMC/reliability engineer for various flight program, performed analysis and test as required to ensure the success of the mission.

Special committee assignments: member of NASA/AF panel on electromagnetic and electrostatic hazards associated with astronaut EVA; member of NASA Space Station Electrical power system grounding tiger team; chairman of the Space Station Environment Work Bench Workshop; member of special Voyager, Galileo and Magellan spacecraft anomalies investigation team.

Aerojet Corporation - 1986 to 1990,
consultant, provided advice on ESD hazard and avoidance for the Peace Keeper Missile program

Plasma Physics Laboratory, UCLA - 1979 to 1980
development engineer, performed research in plasma physics.

Award

NASA Exceptional Service Medal recipient, "In recognition of major contributions to the understanding and mitigation of the adverse effects of space plasma charging", 1994.

Patent

US Patent 5162969, "Dielectric Particle Injector for Material Processing".

Reference is available upon request, a list of publications is attached.

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EXTERNAL PUBLICATIONS

1. "Caviton Particle Interaction", P. Leung, A. Wong and D. Eaglestone, *Physical Review Letters*, 28, 1407, 1977
2. "Interaction of Particle Beam with Non-linear States". Ph.D. thesis, University of California, Los Angeles, 1979.
3. "Formation of Double Layers" P. Leung, A. Wong and B. Quon, *Phys. Fluids* 23, 992, 1980.
4. "Observation of Electromagnetic Radiation at Twice the Plasma Frequency Generated by Beam-Plasma Interactions", P. Leung, et. al., *Physics of Auroral Arc Formation*, Geophysical Monograph, 25, Edited by S. Akasofu and J. Kan, 1981.
5. "Characteristics of RF Resulting from Dielectric Discharges", P. Leung and G. Plamp, *IEEE Transactions on Nuclear Sciences*, NS-29, 1610, 1982.
6. "Plasma Wave Collapse Generated by the Interaction of Two Oppositely-Propagation Electron Beams with a Plasma", P. Leung, Q. Tran and A. Wong, *Plasma Physics*, 24, 567, 1982.
7. "Discharge Characteristics of a Simulated Solar Array", P. Leung, *IEEE Transactions on Nuclear Sciences*, NS-30, 4311, 1983
8. "Galileo Internal Charging Program", P. Leung et. al., *Proceeding of the 1983 Spacecraft Environment Interactions Conference*, 1983.
9. "Simulation of External and Internal Electrostatic Discharges at the Spacecraft System Test Level", A. Whittlesey and P. Leung, *Proceedings of Eighth Aerospace Testing Seminar*, 43, 1984.
10. "Characteristics of Electromagnetic Interference Generated by Arc Discharges", P. Leung, *Proceedings of the Ninth Aerospace Testing Seminar*, 40, 1985.
11. "Environment-Induced Electrostatic Discharges as the Cause of Voyager 1 Power-on Resets", P. Leung et. al., *Journal of Spacecraft and Rockets*, 23, 323, 1986.
12. "Quiet Plasma Source", P. Leung, *NASA Technical Brief*, Vol. 10, No. 5, 40, 1986.
13. "Polar-Auroral Charging of the Space Shuttle and EVA Astronaut", W. Hall et. al., *Proceedings of NATO AGARD Conference on the Aerospace Environment at High Altitudes and Its Implications of Spacecraft Charging and Communications*, The Netherlands 1986.
14. "Laboratory Plasma Interaction Experiments", P. Leung, *Proceedings of the Space Technology Plasma Issues in 2001 Workshop*, JPL Publication 86-49, 249, 1986.
15. "Plasma Interactions and Surface/Material Effects", M. Mandel, A. Chutjian, W. Hall, P. Leung, P. Robinson and N. J. Stevens, *Proceedings of the Space Technology Plasma Issues in 2001 Workshop*, JPL Publication 86-49, 3, 1986.
16. "A Laboratory Investigation of Potential Double Layers", P. Leung, *Laser and Particle Beams*, vol. 5, 339, 1987

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PUBLICATIONS(cont'd)

17. "Electrical Conductivity of ZOT after a Long Term exposure to Thermal Vacuum Environment", P. Leung, Proceeding of Spacecraft Charging Technology Conference", 166, 1989.
18. "Potential Structures in the Flow of a Plasma Past an Obstacle in the Presence of a Magnetic Field", S. Gabriel and P. Leung, Physics Letters A, 147, 1, 1990.
19. "Test Conductive Films for Continuity", P. Leung, NASA Technical Brief, June 1990.
20. "Observation and Impact of Dust Particles on Magellan Mission to Venus", P. Robinson, P. Leung, S. Gabriel, A. Wong and R. Wuerker, Proceedings of the Vehicle Environment Interactions Conference, Edited by R.E. Erlandson and C.I. Ming, 1991.
21. "A Method to Reduce the Electrostatic Discharge Energy of Thermal Control Paint Surfaces", NASA Technical Brief, p. 60, June 1992.
22. "Lightweight, High-Yield Photo cathode", P. Leung and S. Gabriel, NASA Technical Brief, 1992.
23. "A New Colloid Electric Propulsion Device", NASA Technical Brief, 1992.
24. "Dielectric Particle Injector for Material Processing", US Patent 5162969, November 1992.
25. "Multibody-Plasma Interactions: Charging in Wake", J. Wang, P. Leung, H. Garrett and G. Murphy, "Journal of Spacecraft and Rockets, vol. 31, no. 5, 1994.
26. "Transient Structure Current Generated by the Activation of a Squib Device", P. Leung and T. Nguyen, Proceedings of the 1995 IEEE Aerospace Applications Conference, 1995.

NASA PUBLICATIONS

1. "Characterization of EMI Generated by the Discharge of a VOLT Solar Array", P. Leung, JPL Publication 85-82, 1985.
2. "Charging/Discharging Characteristics of Spacesuit Materials", P. Leung, JPL D-3483, 1986.
3. "Final Report for NASA Power Systems RTOP on Environmental Interactions", P. Leung, JPL D-3225, 1986.
4. "Multibody Interactions in Plasmas", P. Leung, JPL D-6752, 1989.
5. "CRAF/Cassini Electromagnetic Compatibility Control Plan", P. Leung, 1991.
6. "Surface Charging/ESD Analysis", P. Leung, NASA Reliability Preferred Practices for Design and Test, NASA Technical Memorandum 4322, 1991.
7. "Pyro-firing Induced Transient Structure Current" NASA Environmental Test and Effectiveness Analysis handbook, 1995.